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January 23, 2015

Mr. Martin Cristofaro R. G. Miller Engineers 16340 Park Ten Place Houston, Texas 77084

RE: Phase I Fault Study

Wirt Road Drainage and Pavement Sub-Project II

WBS No. M-000287-002-3

City of Houston, Harris County, Texas

Dear Mr. Cristofaro:

Per your request, Crouch Environmental Services, Inc. (CESI) has prepared a Phase I Fault Study for the Long Point Fault in the area of Wirt Road between Hammerly Boulevard and Long Point Road in Houston, Texas. This Phase I Fault Study has been prepared in accordance with the guidelines of the City of Houston Design Manual Chapter 11.09: Geotechnical and Environmental Requirements (July 2012), and the Houston Geological Society Phase I Recommended Standards of Practice for Investigating Geologic Faults in the Texas Gulf Coast Region (March 1985). This report was prepared by a Texas-licensed geoscientist, Richard Rexroad, who has substantial experience and training in investigating faulting in the Texas Gulf Coast Region. Attachment A oresents a summary of Mr. Rexroad's qualifications for conducting this Phase I Fault Study.

The scope of work for performance of a Phase I Fault Study in accordance with the guidelines specified above consists of the following tasks:

- 1. Literature Review
- 2. Remote Sensing Study with Examination of Historical Aerial Photographs
- 3. Study of Geologic Structure Maps
- 4. Examination of Topographic Maps
- 5. Detailed Field Reconnaissance

The following sections present information specific to the Long Point Fault in the area of Wirt Road between Hammerly Boulevard and Long Point Road in Houston, Texas.

Task 1 – Literature Review

The Long Point Fault is one of the most pronounced of the numerous growth faults present in the Houston area (Engelkemeir and Khan, 2007). These growth faults are dip-slip faults that dip generally to the south, with the downthrown side of the fault present to the south of the upthrown side of the fault. Growth faults characteristically display increasing displacement with depth as well as thickening of sediments on the downthrown side of the fault (Shah and Lanning-Rush, 2005). These features are generally considered to be evidence of a long history of continued fault movement.

Plate 1 (Kranz, 2014) depicts the location of the Long Point Fault in the area of Houston, Texas between Hempstead Highway and Interstate Highway 10 (IH 10). Plate 2 (Verbeek and Clanton, 1981) depicts the location of the Long Point Fault relative to other fault systems mapped in the greater Houston area.

Rates of vertical displacement along the Long Point Fault have averaged more than 2 centimeters per year (0.80 inch per year) since the early 1960s (Verbeek and Clanton, 1981). Based on thickness data for geologic units deposited on both sides of the Long Point Fault, Verbeek and Clanton (1981) postulate 3 meters to 4 meters (10 feet to 13 feet) of vertical movement during lower Pleistocene (Lissie Formation) time, minimal vertical displacement during upper Pleistocene (Beaumont Formation) and much of Holocene time, and a relatively sudden reactivation that has added approximately 1 meter (3 feet) or more of vertical displacement over the past century. This recent reactivation of the Long Point Fault may be attributed to subsidence associated with groundwater withdrawal in the urban Houston area.

Task 2 – Remote Sensing Study

The remote sensing study portion of this Phase I Fault Study consists of examination of historical aerial photographs of the study area obtained from Environmental Data Resources, Inc. (EDR) and a review of pertinent publications presenting relevant remote sensing data interpretation.

Table 1 presents a summary of the aerial photographs obtained as a result of EDR Inquiry No. 4134127.2 (Attachment B).

Table 1 – Historical Aerial Photographs

Scale	Image Type	Source
1" = 500'	Black & White (B&W)	USGS ⁽¹⁾
1" = 500'	B&W	USGS
1" = 500'	B&W	USGS
1" = 500'	B&W	USGS
1" = 500'	B&W	USGS
1" = 500'	B&W	USGS
1" = 500'	B&W	USGS
1" = 500'	B&W	USGS
1" = 500'	Infrared (IR)	USGS/DOQQ ⁽²⁾
1" = 500'	True Color (TC)	USDA(3)/NAIP(4)
1" = 500'	IR	USDA/NAIP
1" = 500'	TC	USDA/NAIP
	1" = 500' 1" = 500'	Scale Image Type 1" = 500' Black & White (B&W) 1" = 500' B&W 1" = 500' Infrared (IR) 1" = 500' True Color (TC) 1" = 500' IR

⁽¹⁾ USGS: United States Geological Survey

No evidence of the Long Point Fault was apparent based on examination of these aerial photographs.

⁽²⁾ DOQQ: Digital Ortho Quarter Quad

⁽³⁾ USDA: United States Department of Agriculture

⁽⁴⁾ NAIP: National Agricultural Imagery Program

In response to substantial flooding associated with Tropical Storm Allison in June 2001, the Federal Emergency Management Administration (FEMA) and the Harris County Flood Control District (HCFCD) commissioned a study of floodplain elevations in the Houston area. Light detection and ranging (Lidar) data were used to record subtle changes in topography and elevation within Harris County, Texas. Khan and Engelkemeir (2008) identified over 300 faults in the Houston area. Figure 1 presents the results of their investigation and shows the location of the Long Point Fault System and associated Eureka Heights Fault System in the northwest portion of the Houston metropolitan area.

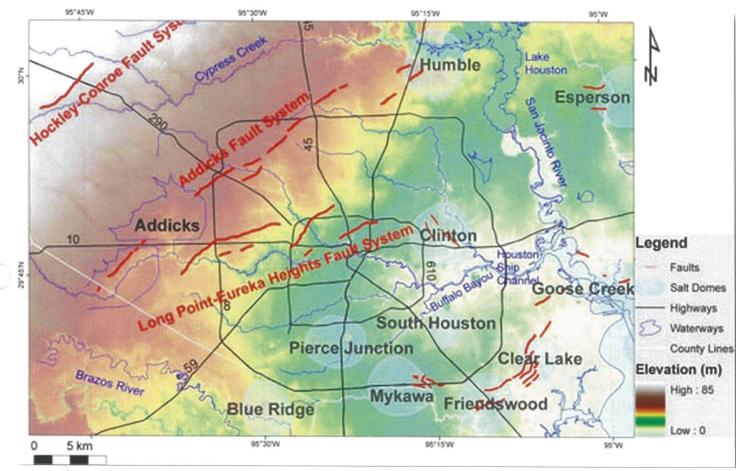


Figure 1 – Lidar Image Depicting the Long Point Fault System and Other Fault Systems in the Houston Area (Khan and Engelkemeir, 2008)

The U. S. Geological Survey (USGS), in conjunction with the Harris-Galveston Coastal Subsidence District, used a Lidar-derived digital elevation model (DEM) to enhance the precision of fault locations in the Houston area (Shah and Lanning-Rush, 2005). Figure 2 depicts the location of the Long Point Fault in the area between Hempstead Highway and IH 10, based on Lidar DEM mapping.

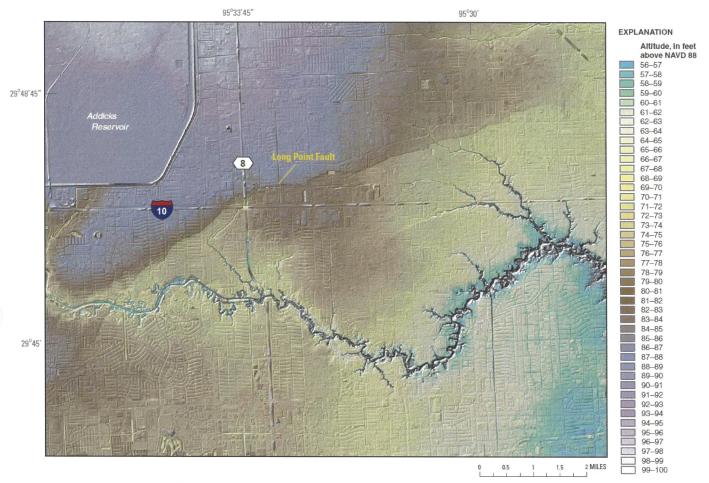


Figure 2 – Location of Long Point Fault based on Lidar DEM Mapping (Shah and Lanning-Rush, 2005)

Task 3 – Study of Geologic Structure Maps

No geologic structure maps of the Long Point Fault were obtained as a result of the Task 1 Literature Review. The attached Plate 3 from Van Siclen (1981) presents a generalized geologic block diagram showing typical surface and subsurface features associated with a growth fault system such as the Long Point Fault System.

Note in the attached Plate 2 that the Piney Point West and Piney Point East Faults appear to be complementary relief faults to the Long Point (growth) Fault, as depicted conceptually in Plate 3.

<u>Task 4 – Examination of Topographic Maps</u>

Topographic maps of the study area were obtained from EDR. Table 2 presents the details of the maps examined for Task 4.

Table 2 – Historical Topographic Maps

Year	Contour Interval	
1922	1 foot	
1946	5 feet	
1955	5 feet	
1967	5 feet	
1982	5 feet	
1995	5 feet	

These topographic maps are presented in Attachment C. The approximate location of the Long Point Fault has been drawn on each of these maps, based on visual observation during Task 5 Field Reconnaissance and information presented in Plate 1. The downthrown side of the fault is marked with a triangle on each of these maps.

The 1922 topographic map is the only topographic map with a 1-foot contour interval. The relatively closely spaced contour lines in the area proximal to Long Point Road (to the west of the drawn-in fault symbol) as compared to the generalized regional topography exclusive of creeks and gullies in the area suggests the presence of the scarp of the Long Point Fault. The contour interval on the remaining topographic maps is 5 feet, with resultant loss of detail necessary to identify the presence of the Long Point Fault.

Note, however, that the surficial elevation of the area of Wirt Road immediately south of Amelia Road (which runs parallel to and one block north of Long Point Road) is mapped as decreasing from approximately 80 feet above mean seal level (+80' MSL) in 1922, 1946, 1955, and 1967 to approximately +78' MSL in 1982 and 1995. This apparent decrease in elevation in the study area may be related to regional groundwater withdrawal, which has been postulated to be associated with reactivation of the Long Point Fault during urbanization of the Houston area (Verbeek and Clanton, 1981).

Task 5 – Field Reconnaissance

Site reconnaissance activities for the Phase I Fault Study were conducted on November 12, 2014. Photographs taken during site reconnaissance activities are presented in Attachment D.

The Long Point Fault trends generally east-west through the study area. As such, its topographic expression is more readily apparent on north-south trending streets in the area than on east-west trending streets. Wirt Road is oriented north-south. After locating the apparent scarp of the Long Point Fault on Wirt Road, the streets running generally parallel to Wirt Road (Johanna Street to the east and Spenwick Street to the west) were examined to verify that the topographic feature located on Wirt Road between east-west trending Amelia Road and Long Point Road is the Long Point Fault. Based on correlation to surficial expressions of faulting located and observed on Johanna Street and Spenwick Street, the topographic feature observed in the 1800 block of Wirt Road, between Long Point Road and Amelia Road, was confirmed to be the Long Point Fault. Figure 3 depicts the approximate location of the deformation zone of the Long Point Fault within the project alignment on an engineering diagram prepared by R. G. Miller Engineers for the project. The deformation zone is located between Stations 11+60 and 14+10.

The reader is referred to Attachment D for detailed observations recorded during field reconnaissance.

Conclusions

The Long Point Fault is an active growth fault extending generally east for several miles from Hempstead Highway to south of IH 10. A Phase I Fault Study was conducted to determine the location of the Long Point Fault along Wirt Road between Hammerly Boulevard and Long Point Road.

No evidence of the Long Point Fault in the study area was apparent on the historical aerial photographs obtained for this study (Attachment B), but the trace of the Long Point Fault is readily apparent on Lidar imagery (Figures 1 and 2). For reference, the approximate trace of the Long Point Fault within the study area has been added to the historical aerial photographs presented in Attachment B. These modified aerial photographs are presented in Attachment E for the reader's reference only.

The 1922 historic topographic map, which was constructed with a 1-foot contour interval, is the only topographic map that provides apparent evidence of the Long Point Fault. The other topographic maps obtained for this study were created with a 5-foot contour interval, which is not adequate to identify evidence of the fault. Regional subsidence associated with fault-related structural deformation is indicated by comparison of topographic maps from 1967 and before to later topographic maps.

Field reconnaissance conducted on November 12, 2014, confirmed the location of the Long Point Fault scarp. The Long Point Fault crosses Wirt Road to the north of John's Auto Service at 1850-B Wirt Road and to the north of the buildings of Cancun Apartments at 1855 Wirt Road. The business located at 1860 Wirt Road (Photo No. 18) straddles the scarp of the Long Point Fault.

The reader is referred to the modified aerial photographs presented in Attachment E for depictions of the approximate trace of the Long Point Fault on historical aerial photographs.

If you have any questions pertaining to the information presented herein, please contact Ryan Robol or the undersigned at 713-868-1043.

Sincerely.

Richard Rexroad, P.G.

Crouch Environmental Services, Inc.

Attachments

Figure 3: Location of Long Point Fault Zone within the Project Alignment

Plate 1: Location of the Long Point Fault

Plate 2: Regional Faulting In the Area of Houston, Texas

Plate 3: Surface and Subsurface Diagram Depicting Typical Features Associated with Growth Faults

Attachment A: Statement of Qualifications

Attachment B: EDR Aerial Photo Decade Package

Attachment C: EDR Historic Topographic Map Report

Attachment D: Field Reconnaissance Photographs

Attachment E: Historical Aerial Photographs Modified with the Addition of the Approximate Trace of the Long Point Fault

References

Engelkemeir, R. M. and S. D. Khan. 2007. Lidar Mapping of Faults in Houston, Texas, USA. Geospehere, vol. 4, no. 1, p. 170-182.

Khan, S. D. and R. M. Engelkemeir (University of Houston). 2008. On Shaky Ground: Geological Faults Threaten Houston. Science Daily, April 29, 2008.

Kranz, D. 2014. Regional Map of the Long Point Fault. Physical Geology (GEOL 1403), Houston Community College.

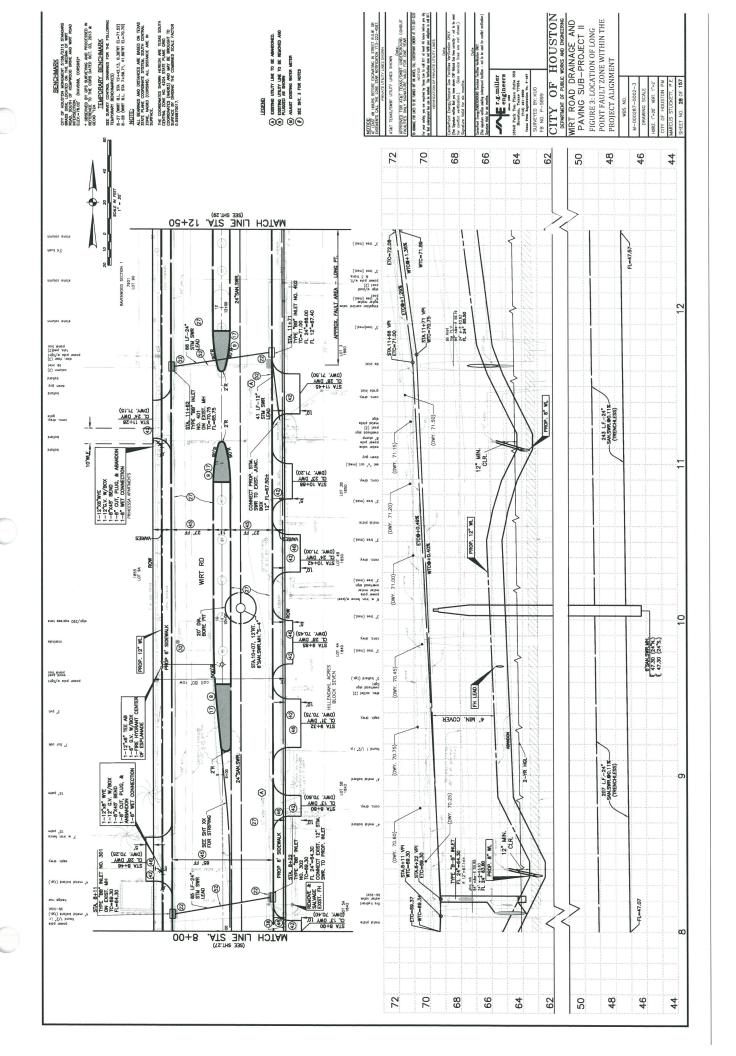
Shah, S.D. and J. Lanning-Rush. 2005. Principal Faults in the Houston, Texas, Metropolitan Area. U. S. Geological Survey Scientific Investigations Map 2874. http://pubs.usgs.gov/sim/2005/2874/sim2874.htm.

Van Siclen, D. C. 1981. Land Development and Fault Investigations in the Houston, Texas Area. *in* Houston Area Environmental Geology: Subsurface Faulting, Ground Subsidence, Hazard Liability: edited by E. E. Etter; Houston Geological Society.

Verbeek, E. R. and U. S. Clanton. 1981. Historically Active Faults in the Houston Metropolitan Area, Texas. *in* Houston Area Environmental Geology: Subsurface Faulting, Ground Subsidence, Hazard Liability: edited by E. E. Etter; Houston Geological Society.

Figure 3

Location of Long Point Fault Zone within the Project Alignment



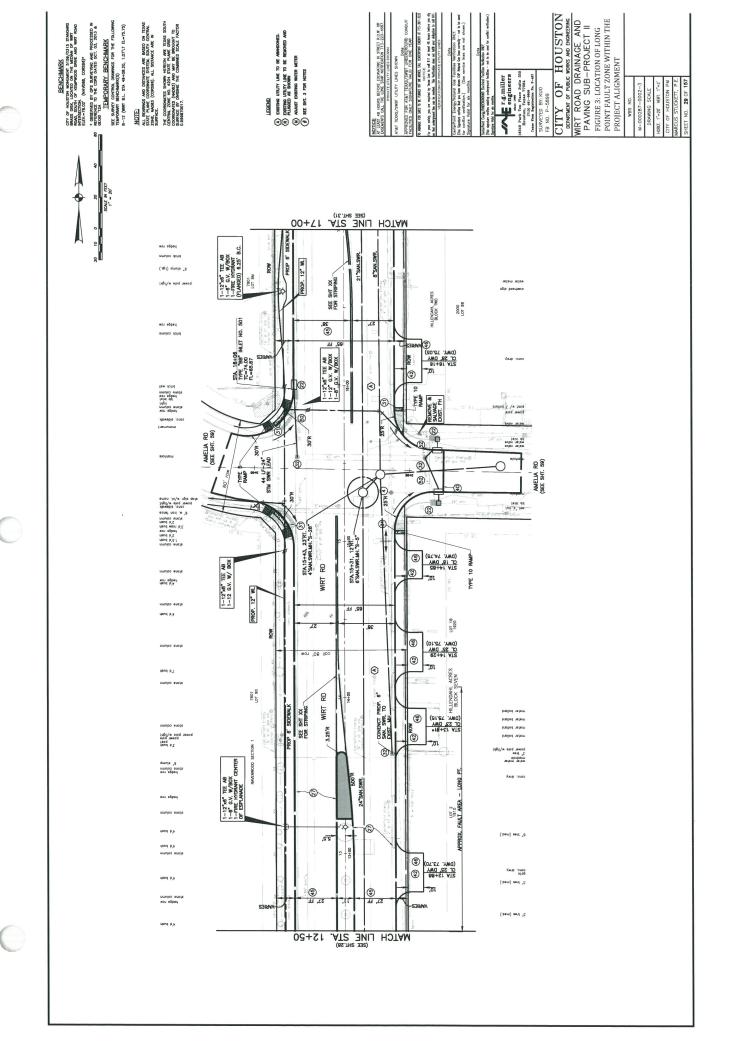


Plate 1 Location of the Long Point Fault

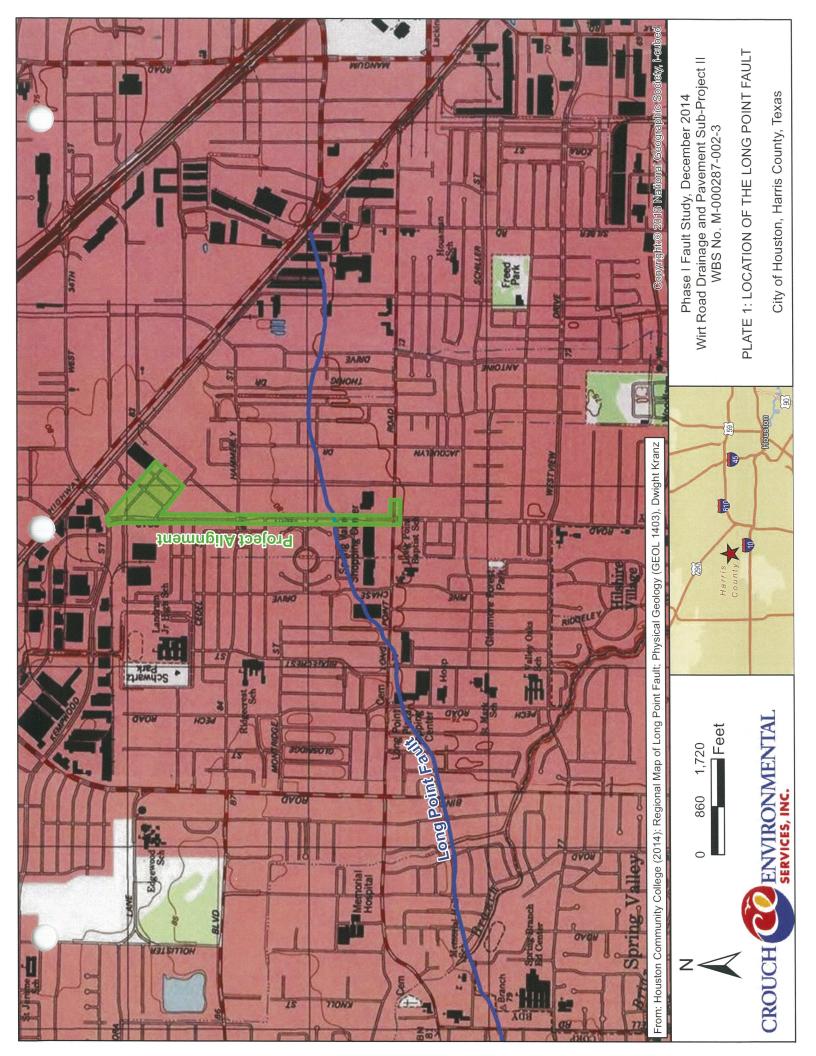


Plate 2 Regional Faulting in the Area of Houston, Texas

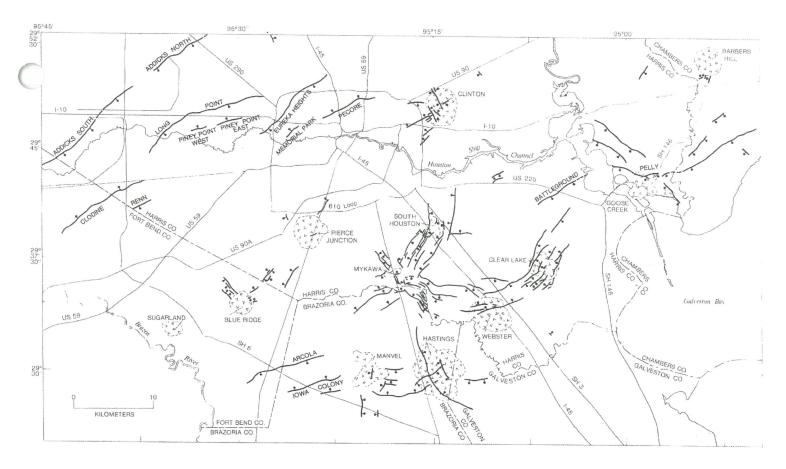




PLATE 2

Regional Faulting In the Area of Houston, Texas

Notes:

- 1. Ball-and-bar symbol indicates downthrown side of fault
- 2. Patterned areas indicate oil fields

Plate 3

Surface and Subsurface Geologic Diagram Depicting Typical Features
Associated with Growth Faults

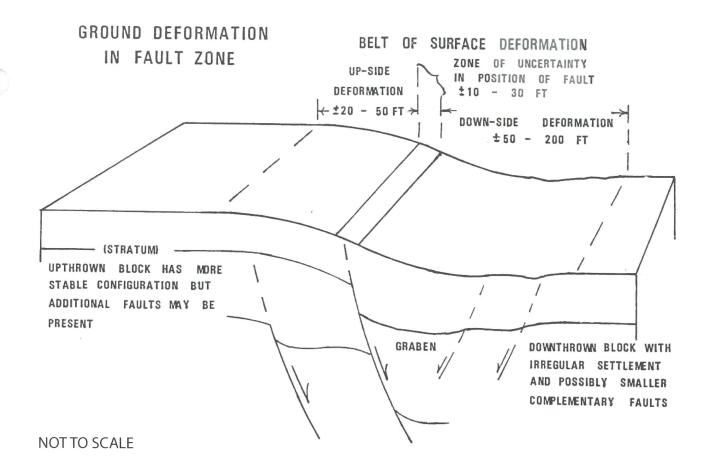


PLATE 3

Surface and Subsurface Geologic Diagram Depicting Typical Features Associated with Growth Faults

Attachment A Statement of Qualifications

Statement of Qualifications for Mr. Richard Rexroad

Mr. Richard Rexroad is a Professional Geoscientist registered in the State of Texas (P.G. No. 1764).

Mr. Rexroad obtained a Bachelor of Science Degree in Geology from Michigan State University in East Lansing, Michigan in 1974, and a Master of Science Degree in Geology from Louisiana State University in Baton Rouge, Louisiana in 1978.

Mr. Rexroad has been employed as a geologist for the USGS and in the oil & gas and environmental consulting industries since 1974. His employment history is as follows:

1974	USGS, Denver, Colorado: summer field assistant
1974 – 1977	Louisiana State University, Baton Rouge, Louisiana: graduate assistant and research assistant
1977 – 1986	Pennzoil Company, Houston, Texas: reservoir and exploration geologist, exploration geophysicist
1987 – 1988	Enviro-Sciences, Inc., Mt. Arlington, New Jersey: environmental geologist
1988 – 1996	NUS Corporation / Brown & Root Environmental, Houston, Texas: environmental geologist
1996 – 2012	Brown and Caldwell, Houston, Texas: environmental geologist
2013 - Present	Crouch Environmental Services, Inc., Houston, Texas: environmental geologist

Mr. Rexroad has conducted extensive geologic and geophysical mapping of the Texas and Louisiana Gulf Coastal region, including detailed structural mapping of faults and other structural features. In conjunction with his work as an environmental geologist, Mr. Rexroad has conducted geologic investigations in Alabama, California, Colorado, Illinois, Louisiana, Mississippi, New Jersey, New Mexico, Ohio, Oklahoma, South Dakota, Texas, and Wyoming.

Mr. Rexroad resides in the Spring Branch area of Houston, Texas, at a location approximately 500 feet north of the Long Point Fault. Mr. Rexroad typically crosses the Long Point Fault multiple times daily.

Attachment B EDR Aerial Photo Decade Package

Long Point Fault At Wirt Road

1860 Wirt Road Houston, TX 77055

Inquiry Number: 4134127.2

November 13, 2014

The EDR Aerial Photo Decade Package



EDR Aerial Photo Decade Package

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

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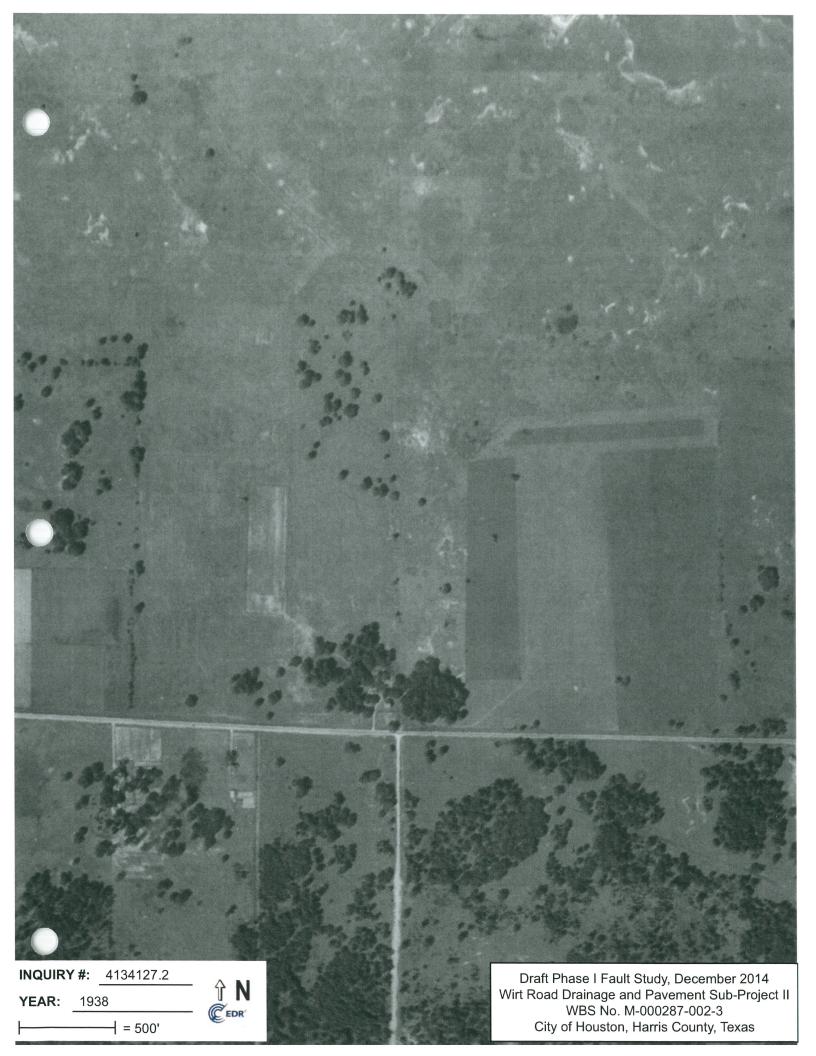
Date EDR Searched Historical Sources:

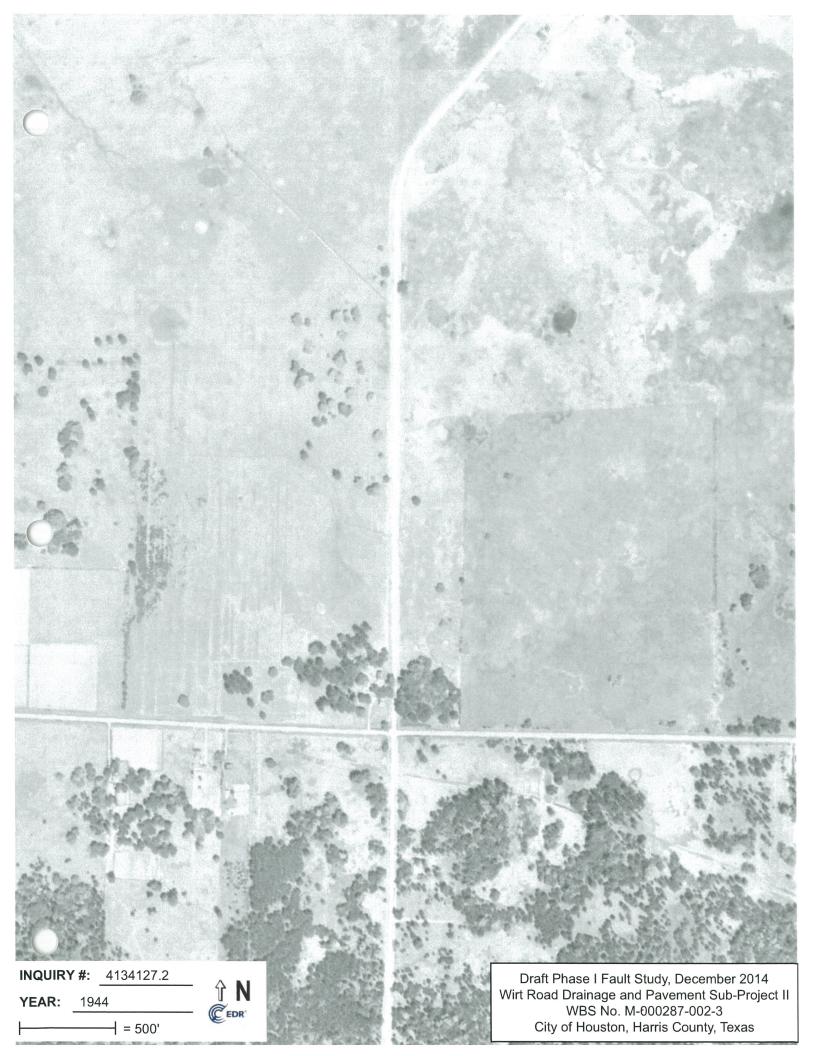
Aerial Photography November 13, 2014

Target Property: 1860 Wirt Road

Houston, TX 77055

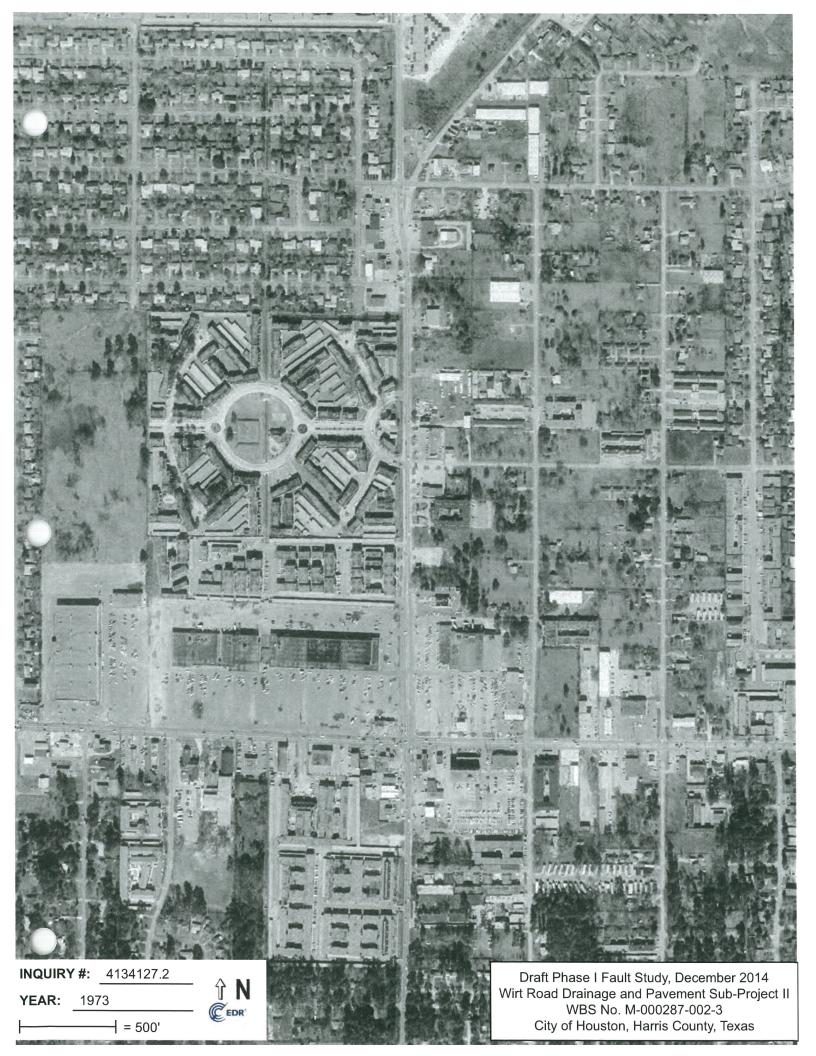
<u>Year</u>	<u>Scale</u>	<u>Details</u>	<u>Source</u>
1938	Aerial Photograph. Scale: 1"=500'	Flight Year: 1938	USGS
1944	Aerial Photograph. Scale: 1"=500'	Flight Year: 1944	USGS
1953	Aerial Photograph. Scale: 1"=500'	Flight Year: 1953	USGS
1966	Aerial Photograph. Scale: 1"=500'	Flight Year: 1966	USGS
1973	Aerial Photograph. Scale: 1"=500'	Flight Year: 1973	USGS
1979	Aerial Photograph. Scale: 1"=500'	Flight Year: 1979	USGS
1983	Aerial Photograph. Scale: 1"=500'	Flight Year: 1983	USGS
1989	Aerial Photograph. Scale: 1"=500'	Flight Year: 1989	USGS
1995	Aerial Photograph. Scale: 1"=500'	/DOQQ - acquisition dates: 1995	USGS/DOQQ
2005	Aerial Photograph. Scale: 1"=500'	Flight Year: 2005	USDA/NAIP
2010	Aerial Photograph. Scale: 1"=500'	Flight Year: 2010	USDA/NAIP
2012	Aerial Photograph. Scale: 1"=500'	Flight Year: 2012	USDA/NAIP







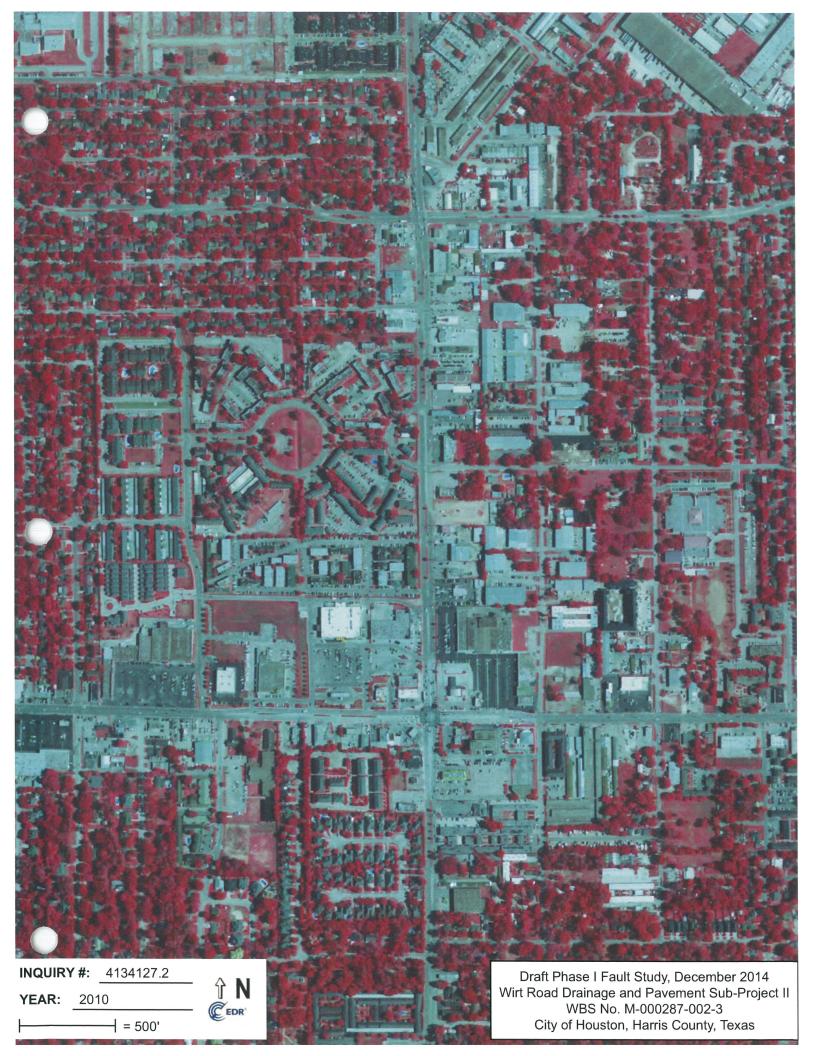














Attachment C EDR Historic Topographic Map Report

Long Point Fault At Wirt Road

1860 Wirt Road Houston, TX 77055

Inquiry Number: 4134127.1

November 14, 2014

EDR Historical Topographic Map Report



EDR Historical Topographic Map Report

Environmental Data Resources, Inc.s (EDR) Historical Topographic Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topographic Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the early 1900s.

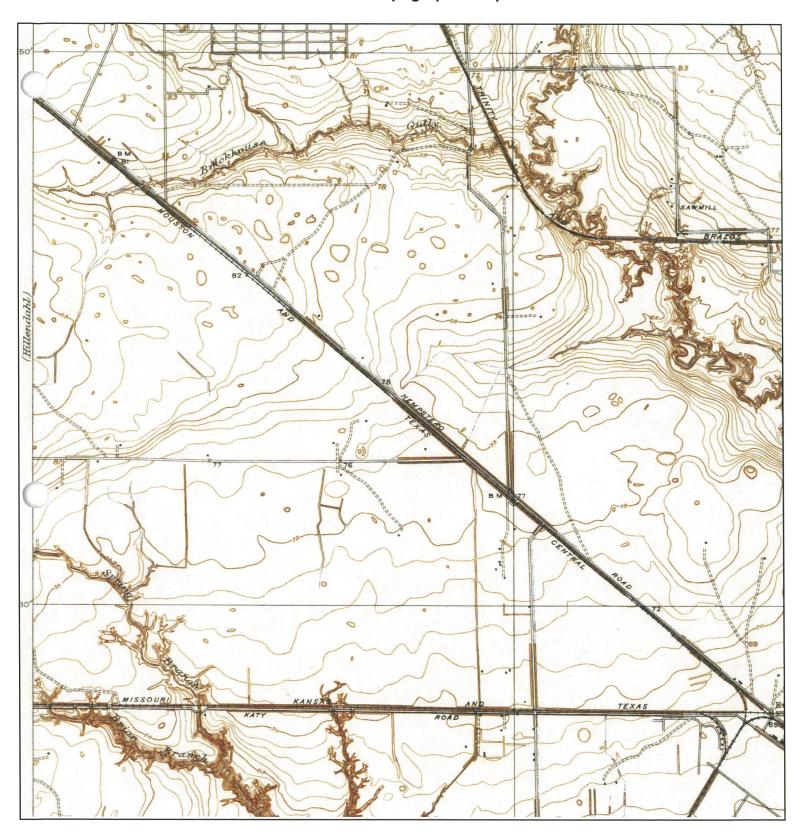
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TARGET QUAD

NAME: HOUSTON HEIGHTS

MAP YEAR: 1922

SERIES: 7.5 SCALE: 1:31680 SITE NAME: Long Point Fault At Wirt

Road

ADDRESS: 1860 Wirt Road

Houston, TX 77055

LAT/LONG: 29.8056 / -95.4848

CLIENT: Crouch Environmental Services





TARGET QUAD

NAME: HOUSTON HEIGHTS

MAP YEAR: 1946

SERIES: 7.5 SCALE: 1:31680 SITE NAME: Long Point Fault At Wirt

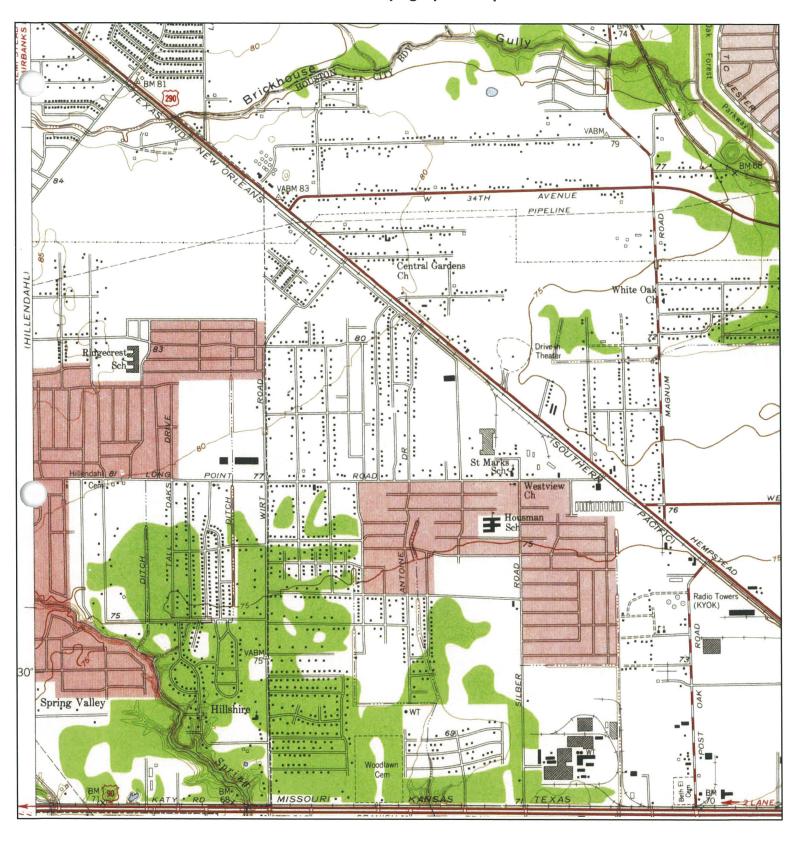
Road

ADDRESS: 1860 Wirt Road

Houston, TX 77055

LAT/LONG: 29.8056 / -95.4848

CLIENT: Crouch Environmental Services





TARGET QUAD

NAME: HOUSTON HEIGHTS

MAP YEAR: 1955

SERIES: 7.5 SCALE: 1:24000 SITE NAME: Long Point Fault At Wirt

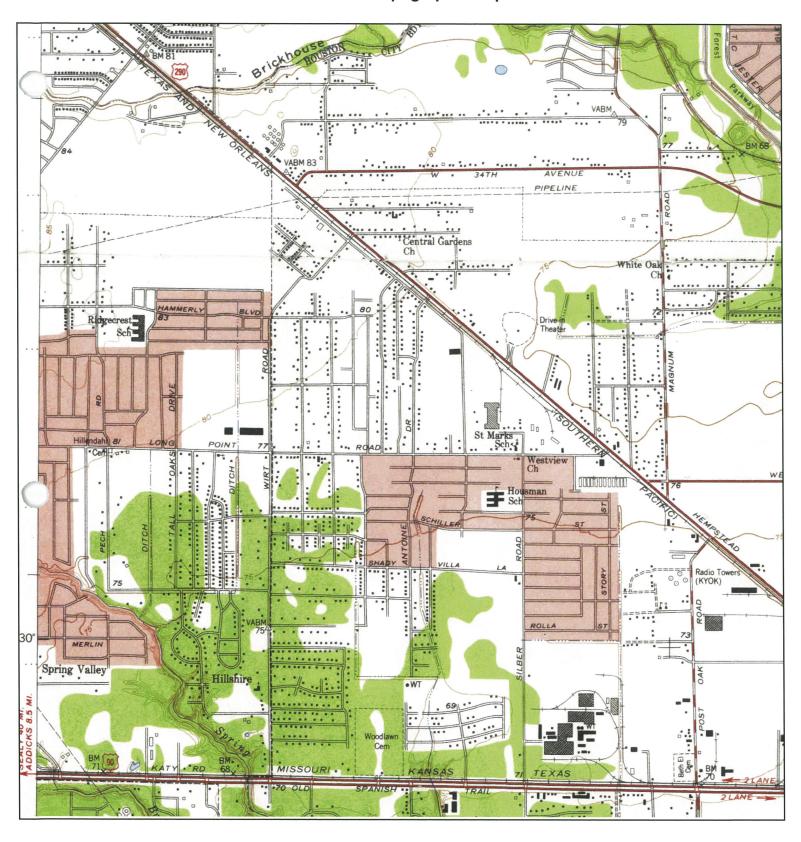
Road

ADDRESS: 1860 Wirt Road

Houston, TX 77055

LAT/LONG: 29.8056 / -95.4848

CLIENT: Crouch Environmental Services





TARGET QUAD

NAME: HOUSTON VICINITY 1

OF 4

MAP YEAR: 1955

SERIES: 7.5 SCALE: 1:24000 SITE NAME: Long Point Fault At Wirt

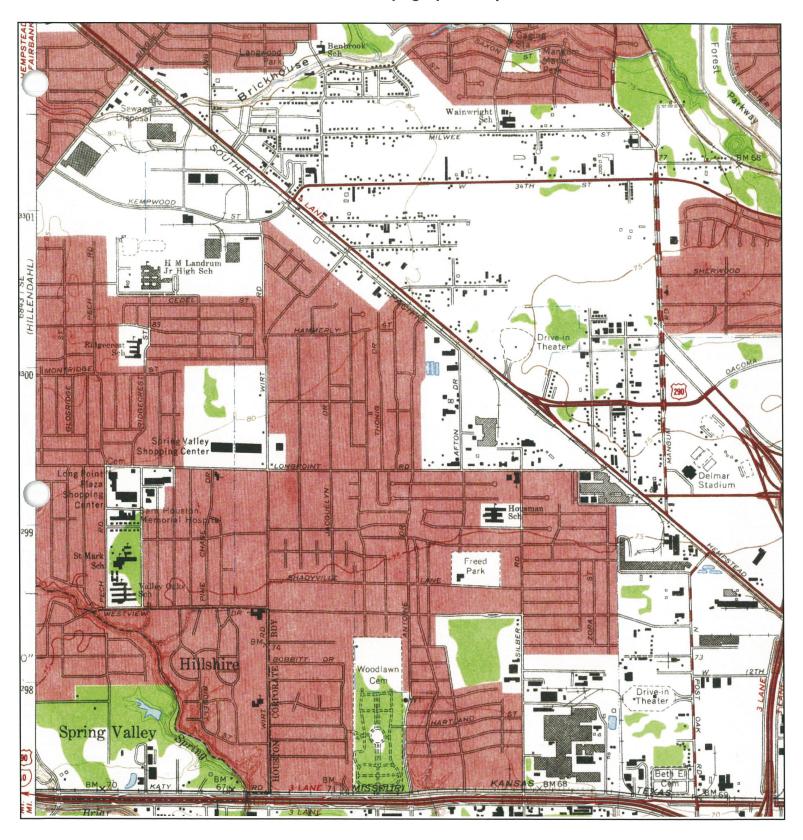
Road

ADDRESS: 1860 Wirt Road

Houston, TX 77055

LAT/LONG: 29.8056 / -95.4848

CLIENT: Crouch Environmental Services





TARGET QUAD

NAME: HOUSTON HEIGHTS

MAP YEAR: 1967

SERIES: 7.5 SCALE: 1:24000 SITE NAME: Long Point Fault At Wirt

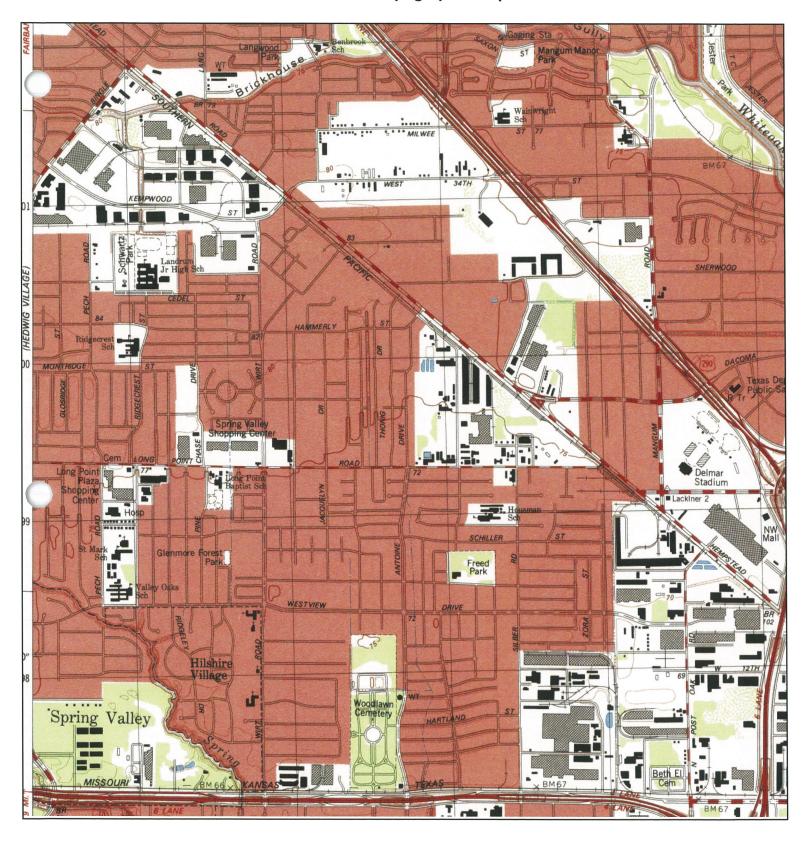
Road

ADDRESS: 1860 Wirt Road

Houston, TX 77055

LAT/LONG: 29.8056 / -95.4848

CLIENT: Crouch Environmental Services





TARGET QUAD

NAME: HOUSTON HEIGHTS

MAP YEAR: 1982

SERIES: 7.5 SCALE: 1:24000 SITE NAME: Long Point Fault At Wirt

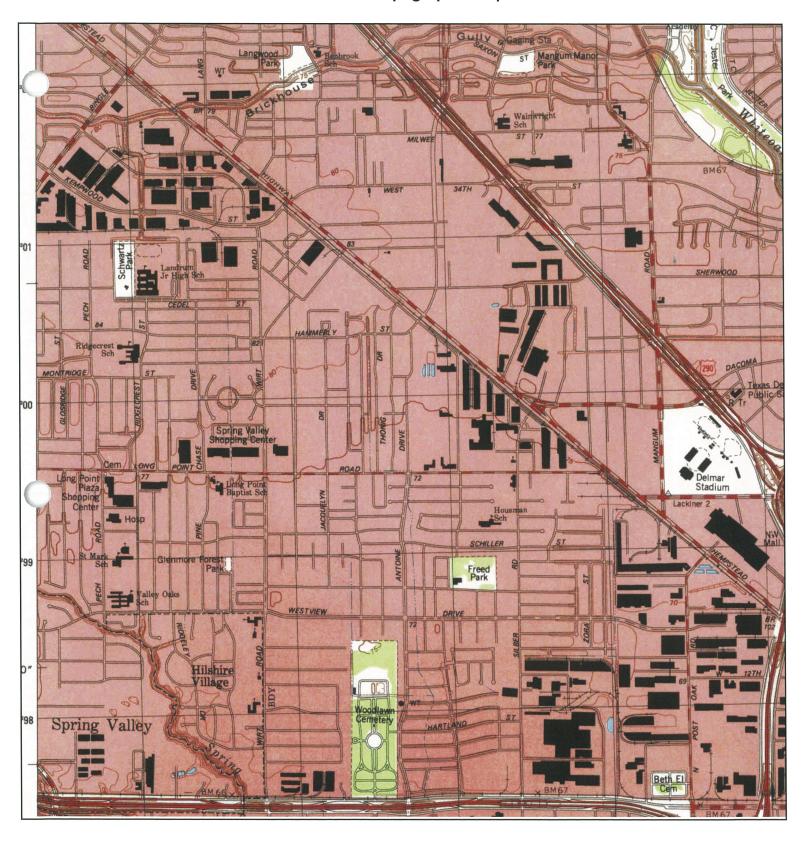
Road

ADDRESS: 1860 Wirt Road

Houston, TX 77055

LAT/LONG: 29.8056 / -95.4848

CLIENT: Crouch Environmental Services





TARGET QUAD

NAME: HOUSTON HEIGHTS

MAP YEAR: 1995

SERIES: 7.5 SCALE: 1:24000 SITE NAME: Long Point Fault At Wirt

Road

ADDRESS: 1860 Wirt Road

Houston, TX 77055

LAT/LONG: 29.8056 / -95.4848

CLIENT: Crouch Environmental Services

Attachment D Field Reconnaissance Photographs

Photo Nos. 1 and 2 depict the surficial expression of the Long Point Fault on Johanna Street, immediately south of Amelia Road.



Photo No. 1: Facing northeast, this is a view near the intersection of Amelia Road (trending east-west) and Johanna Street (trending north-south), the southward slope of the Johanna Street surface (south of Amelia Road) indicates the presence of Long Point Fault. Johanna Street parallels and is located one block east of Wirt Road.



Photo No. 2: Facing north-northwest, this is a view near the intersection of Amelia Road and Johanna Street. The southward-sloping surface of Johanna Street indicates the presence of the Long Point Fault. The blue cars in the background are on the upthrown side of the fault; and the photograph was taken from the downthrown side of the fault.

Photo Nos. 3 and 4 depict the location at which the Long Point Fault crosses Amelia Road, to the east of its intersection with Johanna Street.



Photo No. 3: Facing east, this is a view of Amelia Road near its intersection with Johanna Street. The Long Point Fault crosses Amelia Road at a low angle. The tree's shadow on the sidewalk and roadway is near the area of greatest fault-related deformation. The photograph was taken from the upthrown side of the fault, and the downthrown side of the fault is visible in the background area of the photograph.



Photo No. 4: Facing east-northeast, this is a view along Amelia Road near its intersection with Johanna Street. The vehicle in the center of the photograph is crossing from the upthrown side to the downthrown side of the Long Point Fault.

Photo Nos. 5 through 7 depict the southward slope of Spenwick Street as it crosses the Long Point Fault to the west of Wirt Road.



Photo No. 5: Facing north-northwest, this is a view along Spenwick Street south of its intersection with Amelia Road. The photograph was taken from the downthrown side of the Long Point Fault, and the blue vehicle in the background is on the upthrown side of the fault. Spenwick Street parallels and is located one block west of Wirt Road.



Photo No. 6: Facing south-southeast, this is a view along Spenwick Street near its intersection with Amelia Road. The southward slope of the road surface indicates the presence of the Long Point Fault.



Photo No. 7: Facing northeast, this is a view across Spenwick Street, which slopes southward across the Long Point Fault. A close-up of the apartment building on the east side of Spenwick Street (in the right of this photograph) is presented as Photo No. 8.

Photo Nos. 8 and 9 show a repair of fault-related structural deformation of the wall of an apartment building located on the east side of Spenwick Street.



Photo No. 8: Facing east, this is a close-up view of the wall of the apartment building seen in Photo No. 7. Irregularities in the brick facing of the building are likely due to structural deformation associated with the Long Point Fault.



Photo No. 9: Facing northeast, this is a view of the southwest corner of the apartment building.

Photo No. 10 shows the location of the Cancun Apartments complex at 1855 Wirt Road. The red buildings of the Cancun Apartments complex shown in Photo No. 10 are located on the downthrown side of the Long Point Fault along Wirt Road. A portion of the Cancun Apartments complex that straddles the Long Point Fault to the west along Spenwick Street is shown in Photo Nos. 8 and 9.



Photo No. 10: Facing northwest along Wirt Road, this is a view of a portion of the Cancun Apartments complex (1855 Wirt Road) that is situated immediately downthrown of the Long Point Fault.

Photo Nos. 11 through 13 depict the southward slope of Wirt Road as it crosses the Long Point Fault.



Photo No. 11: Facing north-northwest, this is a view from the median of Wirt Road at 1855 Wirt Road. The red vehicle is crossing from the upthrown to the downthrown side of the Long Point Fault.



Photo No. 12: Facing north-northeast, this is a view from 1855 Wirt Road. The white vehicle in the left portion of the photograph is about to pass from the upthrown side of the Long Point Fault down the fault scarp.



Photo No. 13: Facing north-northeast, this is a view from 1855 Wirt Road. The red car is on the fault scarp between the upthrown and downthrown sides of the Long Point Fault.

Photo Nos. 14 and 15 show a wall that has been deformed apparently due to the presence of the Long Point Fault



Photo No. 14: Facing south-southwest, this is a view of the property at 1855 Wirt Road. See Photo No. 15 for a detail from this photograph.

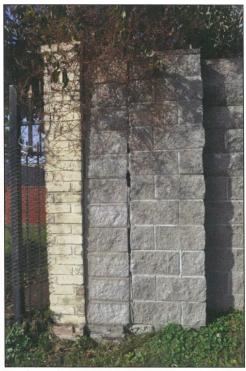


Photo No. 15: Facing west, this is a close-up view near the north property line at 1855 Wirt Road. The offsets along the vertical crack in the gray wall are likely due to deformation associated with the Long Point Fault (upthrown to right, downthrown to left).

Photo No. 16 depicts the southward slope of Wirt Road as it crosses the Long Point Fault. Structural deformation of the curb along the median of Wirt Road that is likely fault-related is shown in Photo No. 17.



Photo No. 16: Facing south from the west side of Wirt Road, this photograph was taken at or near the upthrown side of the Long Point Fault. Vehicles on Wirt Road are on the downthrown side of the fault.



Photo No. 17: Facing southwest, this is a view from the east side of Wirt Road. The irregularities present along the median curb are likely a result of deformation associated with the Long Point Fault.

The noticeable southward slope of ground surface along the fault scarp at 1860 Wirt Road is shown in Photo No. 18. The southward slope of Wirt Road as it crosses the Long Point Fault is again shown in Photo No. 19. The business located at 1850-B Wirt Road, as depicted in Photo No. 20, is situated on the downthrown southern side of the Long Point Fault.



Photo No. 18: Facing east, this is a view at 1860 Wirt Road. The water visible in the shadowed area in the left portion of the photograph is flowing downslope along the scarp of the Long Point Fault.



Photo No. 19: Facing northwest, this is a view from 1860 Wirt Road. The red vehicle is travelling south across the scarp of the Long Point Fault.



Photo No. 20: Facing east, this is a view the business located at 1850-B Wirt Road, which is situated on the downthrown side of the Long Point Fault.

Attachment E

Historic Aerial Photographs Modified with the Addition of the Approximate Trace of the Long Point Fault

